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Photoluminescence Studies of ZnO Thin Films on Porous Silicon Grown by Plasma-Assisted Molecular Beam Epitaxy

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ZnO thin films were grown on porous silicon (PS) by plasma-assisted molecular beam epitaxy (PA-MBE). The optical properties of the ZnO thin films grown on PS were studied using room-temperature, low-temperature, and temperature-dependent photoluminescence (PL). The full width at half maximum (FWHM) of the near-band-edge emission (NBE) from the ZnO thin films was 98 meV, which was much smaller than that of ZnO thin films grown on a Si substrate. This value was even smaller than that of ZnO thin films grown on a sapphire substrate. The Huang-Rhys factor S associated with the free exciton (FX) emission from the ZnO thin films was found to be 0.124. The Eg(0) value obtained from the fitting was 3.37 eV, with $\alpha = 3.3 \times 10^{-2}$ eV/K and $\beta = 8.6 \times 10^{3}$ K. The low- and high-temperature activation energies were 9 and 28 meV, respectively. The exciton radiative lifetime of the ZnO thin films showed a non-linear behavior, which was established using a quadratic equation.

Keywords: Zinc oxide, Porous silicon, Molecular beam epitaxy, Photoluminescence